

# WiMAX in Education

Frank Ohrtman  
WMX Systems  
<http://www.wmxsystems.com>  
720-839-4063



Copyright 2007

The “3 A’s”: Access, Affordability, Applications .....	3
Access.....	4
What is WiMAX .....	4
WiMAX is not Wi-Fi .....	5
Technology to the Kid .....	6
Affordability .....	7
Applications.....	10
Literacy.....	10
Numeracy.....	10
Writing.....	11
How big is the market for WiMAX in schools? .....	11
Extrapolating by student head count .....	12
Conclusion and Recommendations .....	12

## **The “3 A’s”: Access, Affordability, Applications**

A laptop computer has powerful implications for educating any student. There are many initiatives around the world to put laptop computers in the hands of school children including “one-to-one” computing and One Laptop Per Child (OLPC). In the United States, this paper projects that for less than 10% of what a public school district receives in annual tax money per student (federal, state and local funding), that school district can equip each student with a WiMAX-enabled laptop extending the school intranet’s content and application to the student at home.

WiMAX is a very powerful wireless internet access technology. For an estimated \$1 per month per student or a one-time cost of about \$40 (depending on population density) a school district can deploy a WiMAX network linking student laptops to school intranet content and instructional software 7x24x365.

The market for providing WiMAX infrastructure to every public school student in the US is about \$1.8 billion. One-to-one computing will inevitably drive WiMAX uptake in the public sector. WiMAX vendors, service providers and system integrators would do well to get their piece of this potentially lucrative market.

This paper describes the opportunity for educators and vendors alike in terms of the “3 A’s”: access (how one connects to the network, affordability (clever ways to pay for it or justify the expense) and applications (what its ultimately used for. Finally, this paper discusses the size of the opportunity for school district-wide WiMAX.

## Access

“Access” denotes how one accesses a network. In the case of a landline telephone, access is provided by the copper wire that connects a home or business to the telephone network.

A networked (commercial internet access) laptop might be standard issue for children of higher social-economic status (SES) and may one day be inevitable in American homes and classrooms. The question is how far off is that day? Ten years or two years?

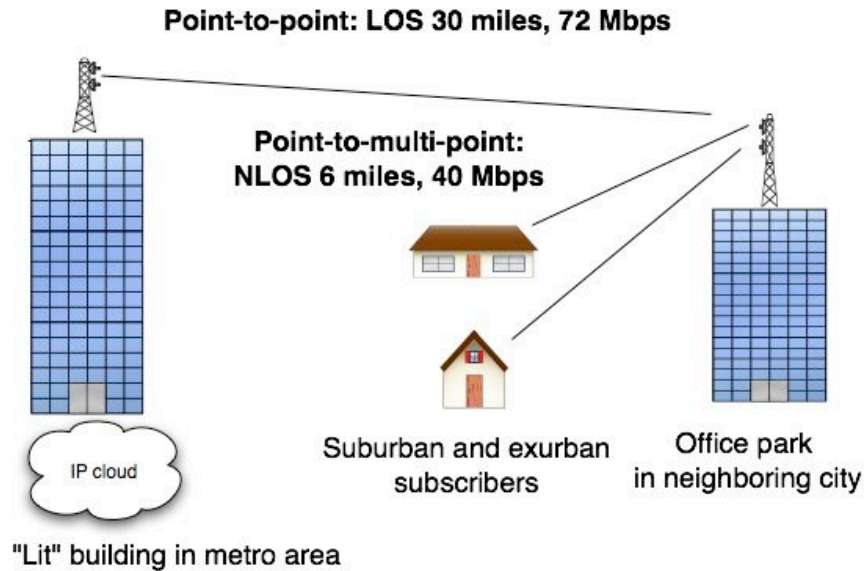


**Figure 1 Are networked laptops inevitable in US schools?**

### What is WiMAX

The following description of WiMAX comes from the vendor group WiMAX Forum<sup>TM</sup>:

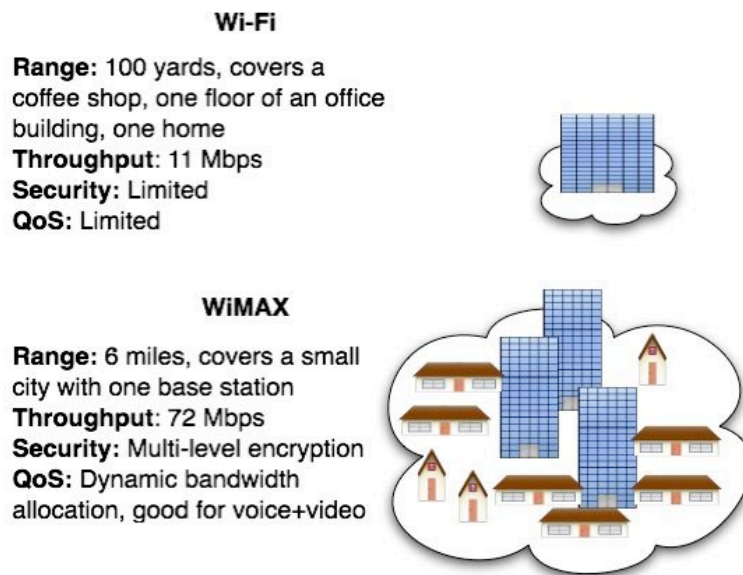
*WiMAX is a last mile wireless broadband access as an alternative to cable/DSL/T1 that provides fixed/portable/mobile non-line-of-sight from base station with a cell radius up to 6 miles point-to-multipoint, non-line-of-sight.*



**Figure 2 WiMAX is a powerful and relatively inexpensive access technology**

WiMAX is not Wi-Fi

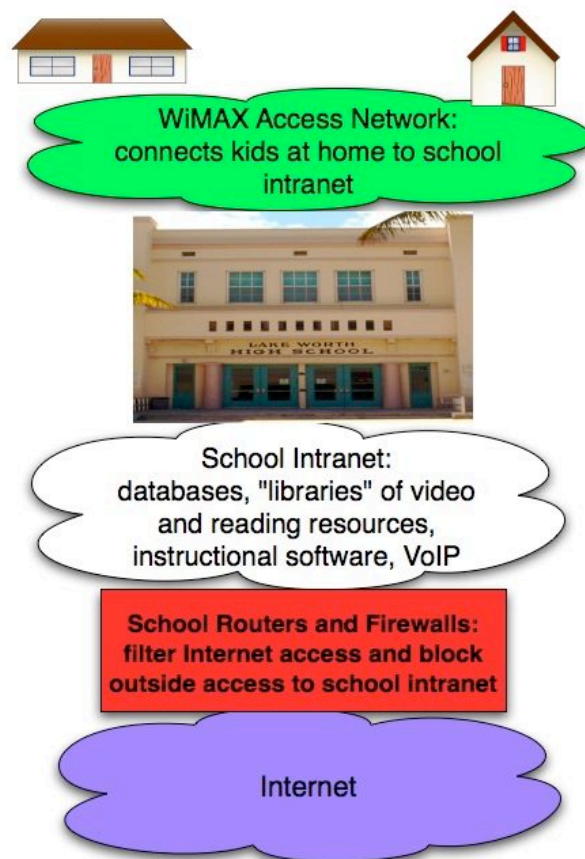
There are many initiatives to bring Wi-Fi to communities across America. As the figure below illustrates, Wi-Fi is inferior to WiMAX in terms of range and throughput (speed) as well as quality of service (QoS) and security.



**Figure 3 WiMAX is greatly superior to Wi-Fi in range, throughput, quality of service and security**

## Technology to the Kid

Education technology most often focuses on bringing technology to the schoolhouse or classroom. A WiMAX-enabled laptop program brings technology to the kid. As the figure below illustrates, WiMAX can connect the student studying at home to the school's intranet and its content and instructional software. The school's intranet is not the Internet with content inappropriate for students (pornography, gambling, etc). By limiting access to a private, school-managed intranet, students cannot be reached by online predators.



**Figure 4 WiMAX can provide student access to the school intranet content and instructional software while blocking student access to harmful content on the Internet**

## Affordability

One of the major attractions to WiMAX is its cost per subscriber. Table 1 below illustrates its cost relative to other technologies in terms of cost per home passed. This low cost per home passed brings it into the realm of possibilities for a school district to build its own private access network independent of commercial operators.

Technology	Capital expenditure for US nationwide network	Cost per home passed
DSL	\$270 billion	\$50*
Cable TV	\$65 billion	\$1,200**
Fiber to the Home	\$93 billion (estimated)	\$2,000***
2/2.5/3 G wireless	\$405 billion	\$50****
WiMAX	\$3 billion (estimated)	<\$10*****

SBC, March 2005

\*\*Hal Varian, University of California and Robert Litan of Brookings Institute (2004)

\*\*\* Wall Street Journal September, 2006

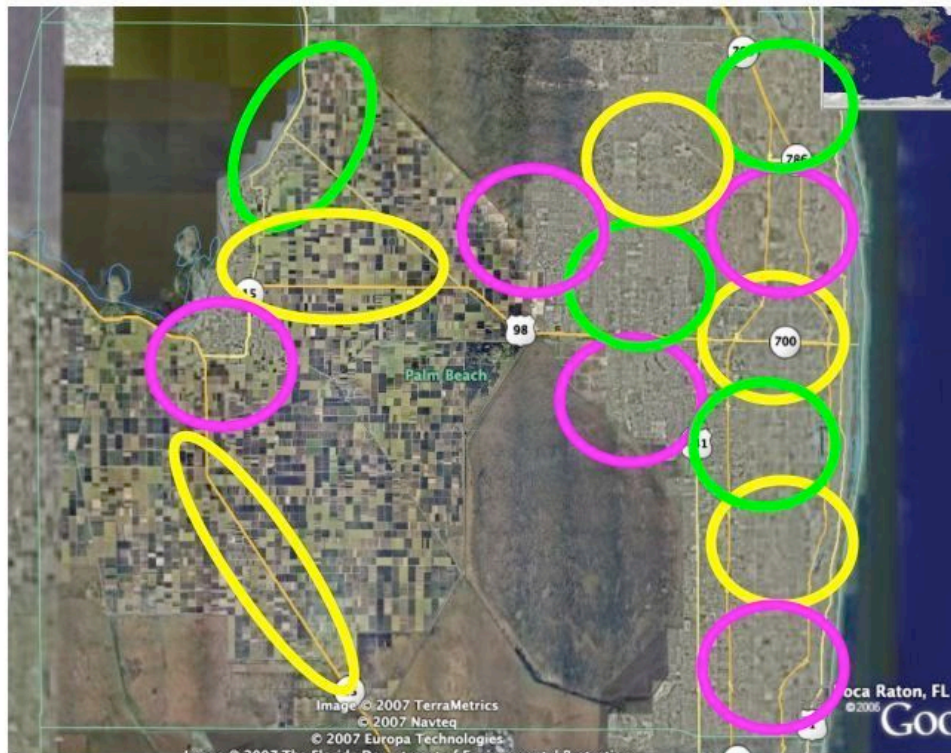
\*\*\*\* Morgan Stanley 2004

\*\*\*\*\* Business Week April 06, 2005

### **Table 1 WiMAX is one of the least expensive access technologies on the market**

The Federal Communication Commission reports that broadband penetration in the US approaches 90% throughout most of the US. However, a survey by Palm Beach County Schools (unscientific by their admission) reveals that 30% of their students have no internet access at home of any kind (dial-up or broadband). In addition many teachers could not get broadband access in their homes (dial-up only). Those 30% of students with no internet access at home are very challenged in keeping up with their peers in homework assignments. For many school districts, it may fall to the district to ensure all students have adequate network access in order to remain academically competitive.

The figure below illustrates potential WiMAX coverage for Palm Beach County, Florida. One estimate to provide WiMAX coverage for the populated areas of the county (where the students live) is \$7 million. With 170,000 students that is approximately \$1 per student for one time capital outlay. With a 48-month lease, that expense could be distributed as \$178,000/month divided among 170,000 students at about \$1/student/month.



**Table 2 Cost to cover Palm Beach County, Florida with WiMAX: \$7 million**

Student laptops can be leased for approximately \$32/month (on a 36 month lease).

Coupled with WiMAX at \$1/month/student the cost to the school district is

\$33/month/student. Allocation of tax money to public schools ranges from \$5,000 to

\$7,000 per student per year. Ergo, deploying a WiMAX network in this school district



and providing a WiMAX-enabled laptop to each child would cost less than 10% of that district's annual, tax dollar per-student allocation.

Another approach to financing a WiMAX network is substituting WiMAX for other expenses such as telecommunications and textbooks. Table 3 compares these expenses.

School district communications costs	Cost now/month	Cost with WiMAX	Monthly savings	Contributing RoI factors
Telephone company T1/T3	\$500/T1 \$5,000/T3	Interconnections to schools eliminates phone company T1/T3	No. T1s x \$500/month No. T3s x \$5,000/month	T1s/T3s eliminated by use of WiMAX
Cell phone	\$100/user	\$0, assumes local service only for school business	X x\$100/month	Portions of existing school district cell phone bill eliminated
VoIP	\$50/phone number/month from phone company	Self contained phone network eliminates those phone bills	\$50/phone number/month	Phone bill savings goes to pay for WiMAX network
Manpower	\$25/hour technicians driving to dispatch office for assignments	Technicians assigned via virtual dispatch;	X hours per week saved @ \$25/hour	How many \$25 hours contribute to cost of WiMAX network?
Textbooks	\$60/book	Textbook equivalent is on laptop	\$60/textbook/school year	Savings on textbooks pays for WiMAX network
Insurance /surveillance cameras	Security personnel to patrol properties; T1s to network cameras	"free" connections to high bandwidth surveillance networks	Replaces telco T1 at \$500/month; lower insurance rates	Savings on camera T1s and insurance rates pays for WiMAX network

**Table 3 WiMAX can provide inexpensive substitutes to current cost elements in a school district budget**

## **Applications**

Critics of a school district-wide WiMAX network in support of a one-to-one computing initiative will inevitably ask, “What will they do with it?” Applications for instruction are the real power, the true value of the WiMAX network. A WiMAX network and one-to-one computing do little for a student’s instruction in and of themselves. The power of the network lies in the applications residing on the school’s intranet accessed by students via the WiMAX network and the one-to-one computing program.

### Literacy

A student armed with a WiMAX-enabled laptop loaded with interactive literacy instructional software would find their daily instruction greatly enhanced. One example would be an English language learner whose English vocabulary would be improved using sight-sound relationships made available via the laptop and software.

At the high school level, a student studying for their American College Tests (ACT) can improve their rate of reading and test taking skills via a series of practice tests offered by these software products. Another example might be a student who has missed a good deal of class due to family emergency can do “credit recovery” (NovaNet is one example).

### Numeracy

Interactive software on a student’s WiMAX-enabled laptop enhances a student’s number sense. A number of software products offer math games that enable practice and development of number sense. At the high school level 3-D graphics are very helpful in understanding trigonometry, physics and biology.

### Writing

Many students find it much easier to write on a computer than with pen and paper. As a result, students are more willing to experiment with their writings (thus writing more) and share drafts of their writings with their peers and teachers. The collaborative learning process is enhanced. The WiMAX-enabled laptop empowers a student to use email thread dialog to discuss materials with both the teacher and their peers. Student blogs encourage writing as a means of student expression. Some see a laptop and laptop applications (word processing, email, web pages, etc) as being ‘real life’, something they can use as everyday problem solving skills where as traditional pen and paper is seen as “non-real life”.

## **How big is the market for WiMAX in schools?**

How many public schools are there in the US? In the 2002 Census of Governments (published once every five years), the United States Census Bureau enumerated the following numbers of school systems in the United States:

13,506 school district governments

178 state-dependent school systems

1,330 local-dependent school systems

1,196 education service agencies (agencies providing support services to public school systems)

In many school districts, the school district is the largest single employer and dollar-wise may be the largest customer of the telephone company and other vendors. Given federal, state and local monies spent by the school district, financially, the school district may be the largest financial entity in many communities.

#### Extrapolating by student head count

According to the US Census bureau, there were 45 million students Kindergarten through 12<sup>th</sup> grade in US public schools as of October 2005. The Palm Beach County Schools case study cited earlier in this paper, indicates an approximate figure of \$40 per student in capital expenditure to build a WiMAX network.

*45 million students at \$40 each = \$1.8 billion market US WiMAX in public schools k-12*

## **Conclusion and Recommendations**

This paper explains opportunities for WiMAX in public schools. WiMAX is primarily a wireless and highly cost effective means of extending the school district's intranet-based content and applications to the student body beyond the school campus and outside of school hours equating to any time, anywhere instruction. WiMAX in education is best explained via the "3 A's" of access (how WiMAX provides student network access), affordability (how a school district can afford a district-wide network) and applications (the real value of the network or how the WiMAX network will be applied to instruction).

There are a number of market drivers for WiMAX in education including one-to-one computing programs, the desire to extend instruction beyond the classroom (i.e. "technology to the kid"), government mandates and funding, however, given the march of technology, the WiMAX-enabled laptop for school kids might be inevitable. Will the school district lead or follow?